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10/532,221	04/22/2005	Takahiro Fujii	040894-7222	8359

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EXAMINER	
BALL, JOHN C	

ART UNIT	PAPER NUMBER
1795	

MAIL DATE	DELIVERY MODE
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/532,221	FUJII ET AL.	
	Examiner	Art Unit	
	J. CHRISTOPHER BALL	1795	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *18 June 2008*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-22* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-22* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Summary

1. This Office Action based on the Amendments and Remarks filed with the Office on June 18, 2008, regarding the FUJII et al. application.

2. Claims 1-22 are currently pending and have been fully considered.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

5. Claims 1-3, 10, 11, 13 – 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over COLE (SCIENCE, vol. 221, no. 4614, Sept. 2, 1983, p. 915-

920) in view of TANAKA (PROCEEDINGS OF THE 35TH INTERSOCIETY ENERGY CONVERSION ENGINEERING CONFERENCE, vol. 2, July 24-28, 2000, pp. 925-930).

COLE discloses thermoelectric energy conversion with solid electrolytes, wherein is shown an operation medium, in the form of liquid/vapor sodium in contact with an electrolyte medium having ion conductivity, in the form of beta"-alumina solid electrolyte (BASE), wherein the operating medium is in contact with a terminal, in the form of an electrical lead, that inherently allows for collection or emission of electrons via redox processes (first paragraph of "Principles of Operation" on page 916 and Figure 2), which are limitations recited in Claims 1 and 13 of the instant application.

COLE also discloses a porous electrode in contact with the other end of the liquid/vapor sodium operating medium, where the electrode is connected to a second electrical lead and it allows the sodium to permeate through it (sixth and seventh sentences of "Principles of Operation" on page 916 and Figure 3), which are limitations recited in Claims 1 and 13 of the instant application.

It is also shown in COLE that the operating temperature in the upper regions is in the range 900 to 1300 K, resulting in a sodium vapor pressure between 0.05 and 2.5 atm at the interface of the solid electrolyte and the sodium operating medium. Also, COLE describes the temperature in the lower region is in the range from 400 to 800K, which results in a sodium vapor pressure in the range from 10^{-9} to 0.01 atm at the interface of the electrolyte and the permeable

electrode (third through fifth sentence, first paragraph of “Principles of Operation” on page 916). It would be obvious to one with ordinary skill in the art to experiment with the two temperature ranges, without extensive experimentation, and arrive at the lowest end of the temperature range for the upper region and the highest end of the temperature range for the lower region, resulting in pressures at the two previously mentioned interfaces that are substantially the same (i.e., 0.05 atm versus 0.01 atm), which is a limitation recited in Claim 1 of the instant application.

COLE discloses that the electrolyte used is beta"-alumina, a solid electrolyte (first through third sentences, second paragraph of "Background" on page 915), which are limitations recited in Claims 2, 3, and 16 of the instant application.

COLE discloses use of molten sodium, which is an alkali metal (first through third sentences, second paragraph of “Principles of Operation” on page 916), which are limitations recited in Claims 10, 11, 17, and 18 in the instant application.

COLE discloses that sodium atoms, the operating medium, absorb their heat of vaporization, leave the porous electrode (i.e., being vaporized at the porous electrode - BASE interface), move through the vapor space, and release their heat of condensation on the condenser surface and are condensed (second sentence of last paragraph of "Principles of Operation" on page 916, and Figure 3), which are limitations recited in Claim 13 of the instant application.

COLE discloses the middle portion of beta"-alumina solid electrolyte (BASE) acts as a partition plate for separating the contact interface between the electrolyte medium and the operating medium and the contact interface between the electrolyte and the permeable electrode (Figure 3), which is a limitation recited in Claim 14 of the instant application.

COLE discloses the contact portion of the operating medium, liquid sodium, and the electrolyte medium, BASE, has a higher temperature (~1200 K) than the condensing portion (~500) (Figure 3), which is a limitation in Claim 15 of the instant application.

COLE does not disclose the contact portion of the of the electrolyte medium with the operating medium disposed at the low-temperature side while the contact portion of the electrolyte medium with the permeable electrode disposed at the high-temperature side, which are limitations recited in Claims 1 and 13 of the instant application. COLE does not disclose where the pressure difference between the contact portion of the operating medium with the first terminal and the condensing portion is equal to or less than the vapor pressure difference of the operating medium which is caused by a temperature difference between the two aforementioned elements, which is a limitation recited in Claim 13 of the instant application.

TANAKA discloses a design for a small-sized AMTEC cell, wherein a molybdenum mesh electrode is in contact with a BASE tube (a solid electrolyte) between two tube heaters (fifth paragraph of “Test Cell Component” portion of

"EXPERIMENTAL" section, page 926 and Figure 3), making this interface disposed at the high-temperature side, and where sodium is raised from a liquid pool via a capillary wick to be in contact the BASE tube from the bottom of device to the high temperature region (first sentence of first paragraph of "Capillary Assembly" portion of "EXPERIMENTAL" section, page 926 and Figure 3), making this interface disposed in the low-temperature side, which are limitations recited in Claims 1 and 13 of the instant application.

TANAKA also discloses the effect of the pressure drops of the tested cell design seem to be negligible (last two sentence of second paragraph of "RESULTS AND DISCUSSION" on page 928), therefore the vapor pressures would be dependant upon the temperature of various portions of the cell. This would lead to a pressure difference between the contact portion of the operating medium with the first terminal and the condensing portion equal to the vapor pressure difference between these two elements due temperature difference, which is a limitation recited in Claim 13 of the instant application.

COLE and TANAKA are analogous art, in that they both deal with the same technical area, alkali metal thermoelectric converters.

At the time of the present invention, it would have been obvious to one with ordinary skill in the art to modify the disclosed thermoelectric energy conversion device of COLE with elements taught by TANAKA since TANAKA's modifications are aimed toward allowing operation at a lower temperature, which

gives longer electrode lifetimes (TANAKA, third and fourth sentences, sixth paragraph of "INTRODUCTION" section on page 925).

6. Claims 4 and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over COLE (SCIENCE, vol. 221, no. 4614, Sept. 2, 1983, p. 915-920) and TANAKA (PROCEEDINGS OF THE 35TH INTERSOCIETY ENERGY CONVERSION ENGINEERING CONFERENCE, vol. 2, July 24-28, 2000, pp. 925-930) as applied to claims 1-3, 10, 11, 13 -18 above, and further in view of COOPER et al. (U.S. Patent No. 5,039,351).

COLE and TANAKA teach the limitations of Claims 1 and 13 of the instant application as stated above.

Neither COLE nor TANAKA discloses a thermoelectric converter wherein the electrolyte medium is comprised of electrolyte materials having different ion conductivity.

COOPER et al. disclose a high performance thin film alkali metal thermoelectric device comprised of a porous structure, which functions as the solid electrolyte, which is a composite of niobium, utilized as a support element which the sodium must diffusion through and placed between the sodium and critical electrolyte, and beta-alumina (Col. 2, lines 33-41, two materials with inherently different ion conductivity, which is a limitation recited in Claims 4 and 20 in the instant application.

COLE, TANAKA, and COOPER et al. are analogous art, in that they deal with the same technical area, alkali metal thermoelectric converters.

At the time of the present invention, it would have been obvious to one with ordinary skill in the art to modify the disclosed thermoelectric energy conversion device of COLE and TANAKA with the electrolyte composite taught by COOPER et al. since the modification increases the electrolyte's ability to withstand mechanical and thermally induced loads, thereby increasing the electrolyte's reliability and making it more economical to produce and maintain (COOPER et al., Col. 1, lines 52-57).

7. Claims 5-9, 21, and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over COLE (SCIENCE, vol. 221, no. 4614, Sept. 2, 1983, p. 915-920) and TANAKA (PROCEEDINGS OF THE 35TH INTERSOCIETY ENERGY CONVERSION ENGINEERING CONFERENCE, vol. 2, July 24-28, 2000, pp. 925-930) as applied to claims 1-3, 10, 11, 13-18 above, and further in view of WRIGHT (U.S. Patent No. 5,143,802).

COLE and TANAKA teach the limitations of Claims 1 and 13 of the instant application as stated above. Additionally, COLE discloses that the electrolyte used is beta"-alumina, a solid electrolyte (first through third sentences, second paragraph of "Background" on page 915).

Neither COLE nor TANAKA discloses a thermoelectric converter wherein the electrolyte medium is comprised of a solid electrolyte that is hollow or tubular-

shaped having a bottom and a liquid electrolyte material is introduced in the hollow member, nor do they disclose the electrolyte medium is comprised of a liquid electrolyte, or that the liquid electrolyte material is a molten salt.

WRIGHT discloses a high-temperature rechargeable electrochemical cell, wherein the cell is comprised of a β″-alumina tube with a closed lower end and an open upper end (Col. 6, lines 25-27), which is are limitations recited in Claims 5, 6, 21, and 22 of the instant application. WRIGHT additionally discloses a space within the β″-alumina tube is flooded with sodium aluminum chloride liquid molten salt electrolyte (Col. 7, lines 5-8), which are limitations recited in Claims 5, 7-9, and 21 of the instant application.

COLE, TANAKA, and WRIGHT are analogous art, in that they deal with the same technical area, alkali metal energy sources.

At the time of the present invention, it would have been obvious to one of ordinary skill in the art to modify the disclosed thermoelectric energy conversion device of COLE and TANAKA with the elements taught by WRIGHT since the modifications impart an ionic pathway which is less tortuous than pathways through a solid electrolyte, facilitating ion diffusion and promoting high power (WRIGHT, Col. 5, lines 55-63).

8. Claims 12 and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over COLE (SCIENCE, vol. 221, no. 4614, Sept. 2, 1983, p. 915-920) and TANAKA (PROCEEDINGS OF THE 35TH INTERSOCIETY ENERGY

CONVERSION ENGINEERING CONFERENCE, vol. 2, July 24-28, 2000, pp. 925-930) as applied to claims 1-3, 10, 11, 14-18 above, and further in view of TILLEY et al. (U.S. Patent No. 4,910,105).

COLE and TANAKA teach the limitations of Claims 1 and 13 of the instant application as stated above.

Neither COLE nor TANAKA discloses a thermoelectric converter wherein the operating medium is impregnated in an impregnation member.

TILLEY et al. disclose high-temperature rechargeable electrochemical cell, wherein the cell is comprised by a powder layer, which functions as an impregnation member, that is saturated with molten sodium, by capillary action sufficient to draw molten sodium, an operating medium, up through the powder layer, which it impregnates, to an solid electrolyte BASE tube against gravity (Col. 4, lines 56-60), which is a limitation recited in Claims 12 and 19 of the instant application.

COLE, TANAKA, and TILLEY et al. are analogous art, in that they deal with the same technical area, alkali metal energy sources.

At the time of the present invention, it would have been obvious to one of ordinary skill in the art to modify the disclosed thermoelectric energy conversion device of COLE and TANAKA with the modification of utilizing the impregnating powder particles taught by TILLEY et al. since the particles automatically engages the outside of the beta-alumina tube at a plurality of regularly and

closely spaced positions, allowing capillarity to cause sodium to engage the beta-alumina tube over substantially its full surface (TILLEY et al., Col. 6, lines 35-39).

Response to Arguments

9. Applicant's arguments, see page 2, filed June 8, 2008, with respect to the specification have been fully considered and are persuasive. The objection of the specification, in particular to the title, has been withdrawn.

10. Applicant's arguments filed June 8, 2008, traversing the 35 U.S.C. 103(a) rejection to claims 1 and 13 have been fully considered but they are not persuasive

The Applicants assert that none of the cited references teaches or suggests the limitation in part of: "the contact portion of the electrolyte medium at the operating medium side and the contact portion of the electrolyte medium at the permeable electrode side are set substantially under the same pressure". However, the Examiner respectfully disagrees, as the previous Office Action outlined how this limitation of recited in instant claim 1 is read on by COLE (Office Action dated December 19, 2007, page 4, lines 4-13).

The Applicants assert that none of the cited references teaches or suggests the limitation in part: "the operating medium is vaporized at the permeable electrode side while the operating medium is condensed at the

condensing portion". However, the Examiner respectfully disagrees, as the previous Office Action outlined how this limitation of recited in instant claim 13 is read on by COLE (Office Action dated December 19, 2007, page 4, line 20 – page 5, line 3). The limitation of instant claim 13: "the contact portion of the electrolyte medium at the operating medium side is disposed in a low-temperature side while the contact portion of the electrolyte medium at the permeable electrode side is disposed in a high-temperature side", is read on by TANAKA (Office Action dated December 19, 2007, page 6, lines 1-10). The limitation of "a pressure difference between the contact portion of the operating medium at the first terminal and condensing portion is equal to or less than the difference in the vapor pressure of the operating medium caused by a temperature difference between the contact portion of the operating medium at the first terminal and condensing portion", is read on by TANAKA (Office Action dated December 19, 2007, page 6, lines 11-18).

The Applicants argues that commonly used AMTEC devices result in even temperatures at the cathode and anode. However, it should be noted that the designed AMTEC device disclosed by TANAKA is not a convention AMTEC device, but an experimental design which makes use of capillary action for transport (see Figure 4 of the reference). Therefore, the argument regarding the standard operation of an AMTEC device is not applicable to TANAKA's design and any combination utilizing TANAKA as a reference. Further, while the drawing and specification of the instant invention are differentiated from the

devices disclosed by COLE and TANKA, the broad language used in the instant claims leads to the claims being rejected using the cited prior art.

Conclusion

11. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

12. Any inquiry concerning this communication or earlier communications from the examiner should be directed to J. CHRISTOPHER BALL, Ph.D. whose telephone number is (571)270-5119. The examiner can normally be reached on Monday through Thursday, 8:00 am to 5:00 pm (EDT).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam Nguyen can be reached on (571) 272-1342. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Nam X Nguyen/
Supervisory Patent Examiner, Art Unit 1753

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AU 1795
09/04/2008